

Weather Notes

NOCTILUCENT CLOUDS IN ALASKA, JULY 27-28, 1957

Noctilucent clouds were observed at Anchorage, Alaska, on the night of July 27-28, 1957. The clouds were first observed at 2350 AST on July 27. They faded from sight completely at 0300 AST on July 28. The clouds were not observable at WBAS Fairbanks (too much light), or at WBAS Northway (low clouds in area).

The following report is extracted from a memorandum from Donald P. Hutchins of Gulkana, Alaska, where the noctilucent clouds were observed by CAA personnel:

At 12:10 a. m. AST, July 28, 1957, extremely high clouds of the noctilucent type were observed in the north quadrant, bearing 320° to 050° (magnetic) from the station with an angular elevation from 10° to 65° above the north-eastern horizon. The greatest concentration of color display appeared to be at azimuth 340° (magnetic) at an elevation angle of 23° above the horizon. Color varied with elevation. Starting at 10° immediately above the smoke layers the color was a light blue-gray and darkened gradually into a deep purple at 60° to 65°. Throughout the blue colors were streaks or slashes of silver which was bordered and spotted with a light pink-gold color resembling brush strokes on a painting. There was a faint smokey-white edge to the overall cloud layer on the western side. After one hour of observation there seemed to be a definite westward movement to the cloud mass. A lower layer of altocumulus moved in rapidly from the southwest and prevented further observation after 1:45 a. m.

As observed at Anchorage by WBAS personnel, the noctilucent clouds were a pale bluish-white near the horizon, changing gradually to a purplish-blue toward the zenith. Several described the clouds as having a distinct silvery appearance but without iridescence; in any event, there were numerous silver streaks. The total mass subtended 70° to 90° of azimuth and 5° to 15° of elevation.

When first observed at 2350 AST, the observer estimated an azimuth bearing of 030°-090° (true) subtending an elevation angle of about 10°. A detailed theodolite observation taken at 0042 AST by Observer David L. Bentley follows:

Azimuth	Minimum Elevation	Maximum Elevation
0°	6.5°	10.2°
010	1.4	10.3
020	1.4	11.6
030	3.0	10.9
040	3.5	12.3
050	5.1	12.0
060	3.7	11.4
070	5.5	7.8
078.9	7.2	----

¹ Lowest possible angle because of natural obstructions.

Mr. Bentley also sighted on the bright spot near the center of the cloud mass as follows:

Time	Azimuth	Elevation
0055 AS	30.0°	8.6°
0056	30.0	8.7
0057	30.0	8.8
0058	30.0	8.9
0059	30.0	9.0
0100	30.0	9.1
0101	30.0	9.2

Observer Richard W. Glommen stated that he first noticed the clouds at 0015 to 0030 AST; he observed the same type clouds on several successive nights in July or August of 1953 at Fairbanks, Alaska. At 0130 AST, Mr. Glommen made the following observation using the theodolite: The cloud mass extended through an



JAMES W. ZOLLER

FIGURE 1.—Photograph of noctilucent clouds, taken 4½ miles east of International Airport, Anchorage, Alaska, July 1957.

azimuth from 337° to 075° (true) with a maximum elevation angle of 27° and minimum elevation angle of 6°.

Although the readings do not permit unique determination of the height of the clouds, rough estimates can be made. Based on roughly concurrent readings at Gulkana and Anchorage, the brightest portion of the cloud mass is estimated to have been 200 to 300 miles from Anchorage, in the neighborhood of Big Delta, at 0042 AST. (Note that azimuth readings from Gulkana are magnetic and must be adjusted to true north to conform with Anchorage readings; magnetic declination at Gulkana is 29° E.) Triangulation, using a distance from Anchorage of 200 miles and an elevation angle of 8°, gives a height of 53 km.; using 250 miles, which is probably closer to the actual distance, the height is estimated at 68 km. Later, when the cloud had moved west, an elevation angle of 16° and distance of 150 to 200 miles give an estimated height of 73 to 97 km.

Mr. James W. Zoller took pictures of the clouds from his home, approximately 4½ miles east of International Airport, Anchorage. One of his prints which portrays actual conditions most closely is reproduced in figure 1. His photographs were taken on Plus-X film at one second with the aperture opening varying from *f* 16 down to *f* 2. Mr. Zoller was unable to obtain a reading on the exposure meter, so it was necessary to experiment to determine the proper exposure. Lack of correct exposure information prevented him from taking pictures every half hour to show cloud movement or changes. The best pictures were taken at *f* 8 to *f* 11 at one second; since this is much faster than the times proposed in official instructions, we feel this information is valuable for future photography of abnormally bright noctilucent clouds. A small bank of high altocumulus or cirrus can be seen in the lower left corner of the picture. Of particular interest are the long parallel silvery streaks aligned along the direction of motion with smaller parallel streaks at right angles, which correspond almost exactly with Vestine's comment (in the "Survey of Data and Theoretical Analysis of the Upper Atmosphere," Final Report, Institute of Geophysics, Uni-

(Continued on page 281)

Under the assumptions made here and in the previous paper [1] (all of which seem realistic), the vertical displacement is related directly to the precipitation that falls from a column and to the moisture conditions in the column (regardless of the time during which the precipitation occurs). Table 2, computed from these assumptions, gives typical values of vertical pressure displacement for rainfall amounts of 0.5 inch, 1.0 inch and 5 inches.

The writer wishes to thank Dr. C. S. Gilman for sug-

gesting the idea which is an elaboration of pages 57-61 of reference [2].

REFERENCES

1. K. R. Peterson, "Precipitation Rate as a Function of Horizontal Divergence," *Monthly Weather Review*, vol. 85, No. 1, January 1957, pp. 9-10.
2. C. S. Gilman, An Expansion of the Thermal Theory of Pressure Changes, Doctoral Dissertation, Department of Meteorology, M. I. T., 1949 (unpublished).

Weather Notes

(Continued from page 272)

versity of California at Los Angeles (Weather Bureau Contract CWB 7904), June 1950; see Part I, p. 16). These parallel bands with associated bright spots may offer good opportunity for estimating cloud movements as the bands appear to be a fairly permanent feature of the cloud mass. Unfortunately, no theodolite readings were taken on these parallel bands.

At the time the clouds were first observed, none of the forecasters or observers on duty had ever seen noctilucent clouds (Mr. Glommen came on duty at 0100 AST). Since the clouds were on the north-northeastern horizon near the sun's rays at this time of year, a few people believed them to be very high cirrus such as have been reported by jet aircraft pilots at altitudes above 40,000 or 45,000 ft. However, after identifying cirrus clouds the following day and observing the behavior of the sunlight on these clouds after sunset, no doubt remained that the clouds observed the previous night were at vastly higher elevations than normal cirrus clouds. The cirrus clouds observed on Sunday night were entirely dark by 2300 AST. The noctilucent clouds seen Saturday night were definitely in the sun's rays and had no significant color changes from the time they were first observed until they disappeared near sunrise. A faint orange glow caused by smoke or haze persisted in the northern sky through the night.—*W. B. Lindley, Meteorologist in Charge, WBAS, Anchorage, Alaska.*

TEMPERATURE AND WIND FIELDS AT THE TIME OF NOCTILUCENT CLOUDS IN ALASKA, JULY 27-28, 1957

Most noctilucent clouds are observed at elevations of 65 to 90 km. in the vicinity of the mesopause between ozonosphere and ionosphere. Although these clouds occur well above the highest layers from which radiosonde data are obtained, an examination of constant pressure charts was made.

The wind flow at 50 and 25 mb. over southern Alaska from 24 hours before to 24 hours after the observation of noctilucent clouds described in Mr. Lindley's note was generally easterly, 5-10 knots. Winds and height changes indicate that a weak trough moved across the area from west to east during the period. At 500 mb., a stronger trough in the westerly winds simultaneously moved in the same direction, suggesting that the trough effect was impressed from below the 50-mb. level.

The temperature field was very weak and typical of that month. Temperatures at both 50 and 25 mb. were warmer to the north so that the easterly winds increased upward through the layer and also for some distance above the 25-mb. level.

At sea level and 500 mb. a weak residual Low moved into the sea area south of Anchorage with little wind flow over the mountain ranges.

A possible explanation of the noctilucent clouds can be found in the apparent general convergence in the vicinity of the trough in a deep layer extending above the 50-mb. level. This is suggested by temperature decreases of one or two degrees at 50 mb. and of about one degree at 25 mb. during a period when cold air advection was not indicated by the streamline-isotherm pattern.

In summation, there is only a slight and inconclusive indication of conditions at 50 and 25 mb. that might explain an unusual event such as noctilucent clouds at a height of possibly 80 km.—*S. Teweles, U. S. Weather Bureau, Washington, D. C.*

RARE WATERSPOUTS IN ALASKA

On August 19, 1957 between 0900 and 1045 PST, two distinct waterspouts were observed in Cross Sound, 20 miles southwest of Cape Spencer Light Station, Alaska. These were sighted by Goody Winthrop, a deep-sea fisherman. During this period, he also observed several other waterspouts in the process of forming. These were observed to start downward from a cloud formation which he estimated to be 1,000 feet high.

On that day Cape Spencer reported an estimated 1,500-foot overcast, visibility 15 miles, temperature 51° F., dewpoint 49° F., and the wind east-southeast at 12 knots. The synoptic situation showed a cold trough over the eastern Gulf of Alaska with a cold cut-off Low over the southeastern gulf. The nearest raob report, taken at Yakutat, 150 miles northwest of Cross Sound, at 0400 PST showed moist unstable air from the 900-mb. level to 600 mb. with an isothermal layer from the surface to 900 mb. The average lapse rate slightly exceeded 4° F. per 1,000 feet and the degree of instability for that stratum was about -1.6° C. (difference between temperature of air parcel after being lifted from 900 to 600 mb. and the observed 600-mb. temperature). Heavy rain showers were reported throughout the area by pilots, and lightning was also reported in Juneau the previous night, which lends support to the statement that the air was unstable.

Another interesting fact was the abnormally high sea temperatures in the eastern part of the gulf. The FWS Research Vessel *Cobb* measured sea temperatures of 64° F. between Cape Ommaney and Cape St. Elias during that period on the 19th although in the Cross Sound area itself the reading was 54° F. It could not be ascertained for sure whether or not the waterspouts appeared where the sea temperatures were abnormally high.—*Gordon D. Kilday, WBAS, Juneau, Alaska.*